PB90-135278

Present and Future EPA (Environmental Protection Agency) Incineration Research Facility

(U.S.) Environmental Protection Agency, Cincinnati, OH

1989

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA
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1. REPORT NO. EPA/600/J-89/241	2.
3. RE PB90-135278	
4. TITLE AND SUBTITLE THE PRESENT AND FUTURE EPA INCINERATION RESEARCH FACILITY	5. REPORT DATE March 1989
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Marta K. Richards	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Risk Reduction Engineering Laboratory U.S. EPA Cincinnati, Ohio 45268	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO. 68-03-3267
12. SPONSORING AGENCY NAME AND ADDRESS Risk Reduction Engineering Laboratory--Cincinnati, OH Office of Research and Development U.S. Environmental Protection Agency Cincinnati, OH 45268	13. TYPE OF REPORT AND PERIOD COVERED General Interest Feature FY88-89
	14. SPONSORING AGENCY CODE EPA/600/14

15. SUPPLEMENTARY NOTES

JAPCA 39(10):1309-1312, Oct. 1989

16. ABSTRACT

The Hazardous and Solid Waste Amendments (HSWA) of 1984 require treatment of specified industrial and hazardous wastes before they can be landfilled. Incineration has been proposed as a solution to the disposal problem of some of these wastes. Since not all wastes can be safely incinerated; parametric factors determine the effectiveness of incineration destruction of toxic materials is necessary. The Environmental Protection Agency operates an experimental facility in Jefferson, Arkansas, which, among other functions, evaluates thermal treatment for hazardous wastes.

This paper discusses the studies that have been carried on at the CRF and the potential for the hazardous waste community to use the physical plant which essentially quadrupled its size. It is now possible for the EPA's Risk Reduction Engineering Laboratory (RREL) to accommodate 3rd-Party users at the Arkansas plant; related information is presented.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES 5
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

EPA/600/J-89/241

The Present and Future EPA Incineration Research Facility

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Congress has given the United States Environmental Protection Agency (EPA) a mandate to regulate the disposal of the Nation's industrial and hazardous wastes. With the recent landfill prohibitions, or "land ban," many of the past practices for disposing of these wastes are no longer available. Incineration has been suggested as a probable alternative path to permanent disposal of many of these troublesome hazardous wastes. To make the decisions regarding whether incineration is a proper waste treatment or disposal option, incinerator testing is needed to investigate the ramifications of thermal destruction.

EPA operates an experimental combustion research facility in Jefferson, Arkansas. One of its functions is to evaluate thermal treatment for hazardous wastes. The Incineration Research Facility (IRF) is operated as a research station to perform incinerator studies which assess process conditions, design, and operating parameters that affect the destruction of hazardous wastes. Measurement of treatment efficiency or destruction and removal efficiency (DRE), residue quality, and air emissions are among the research objectives.

The IRF is a 3100-ft^2 facility (in the process of becoming a 12,400-ft^2 facility). There are two pilot-scale incinerators on site—a rotary kiln incinerator system and a liquid injection incineration system. The rotary kiln incineration system consists of a rotary kiln primary combustion chamber, a fired afterburner, and a primary air pollution control system consisting of a wetted elbow, venturi scrubber, and packed tower scrubber. The liquid injection incineration system consists of a primary combustion chamber and unfired secondary combustion chamber, a quench section, and a primary air pollution control system consisting of a packed tower scrubber followed by a ionizing wet scrubber. Figures 1 and 2 show the two incinerator systems.

Thermal Technology Research

Research conducted at the IRF has supported four major EPA Program Office regulatory development programs. The Hazardous and Solid Waste Amendments of 1984 (HSWA) were incorporated into the Resource Conservation and Recovery Act of 1976 (RCRA) to produce a significant impact upon the disposal of hazardous wastes. The legislation requires the maximum treatment of a waste and encourages alternatives to land disposal (the "land ban"). The IRF was used to assist the Office of Solid Waste (OSW) in Best Demonstrated Available Technology (BDAT) studies relating to the land ban, the emission of trace metals, and the principle organic hazardous constituent (POHC) destruction performance standards regulations. The Office of Emergency and Remedial Response (OERR) and its Superfund Innovative Technology Evaluation (SITE) program were supported in a study involving oxygen-enhanced combustion. Sulfur hexafluoride (SF_6) and its use as a Destruction and Removal Efficiency (DRE) surrogate was tested in support of both OSW and OERR. The Office of Water (OW) and its at-sea incineration program was supported by a test program to validate the Marine Incineration Biological Assessment System (MIBAS). Additional information concerning the described research projects is available in the individual project reports and may be requested from the author.

Listed-wastes Testing

The BDAT test programs that were conducted at the IRF in FY88 are summarized in the following section. The objectives of the tests were two-fold. The studies attempted to establish that these wastes could be incinerated while complying with the hazardous waste incinerator regulations. At the same time, representative samples of the incineration residuals and feed samples were taken, and their hazardous characteristics as they related to the parent waste were determined. The wastes that were studied were some of the listed "K wastes" (*40 Code of Federal Regulations 261.32*). The K List is composed of solid wastes that are listed as hazardous and are from specific sources. The wastes studied and their sources are described in Table I. The waste samples were quite diverse. Each tested waste required a test plan individualized to fit the specific waste and the experimental goal of the study.

SITE Investigation

The EPA SITE program was developed to determine the applicability of innovative waste treatment technologies to cleanup efforts on Superfund sites. A series of tests was performed at the IRF to evaluate an oxygen-enhanced burn-

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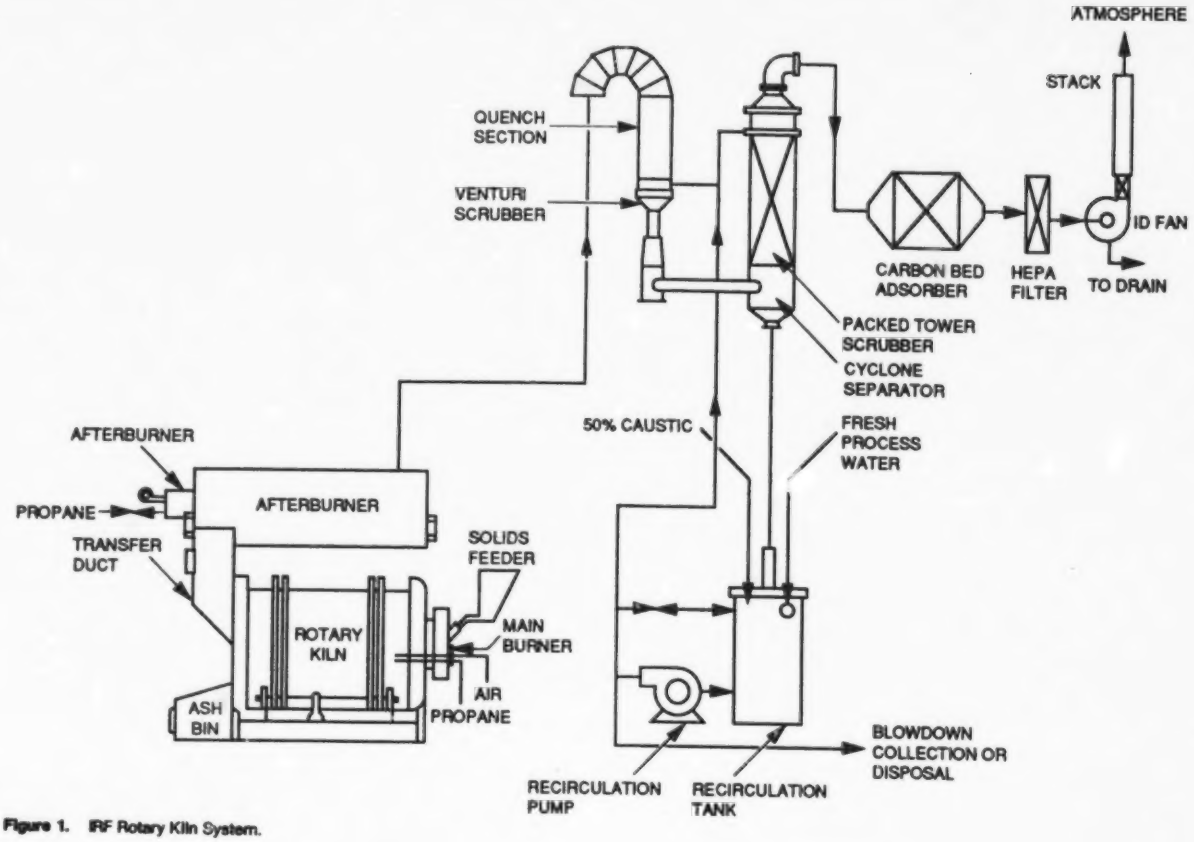

Figure 1. IRF Rotary Kiln System.

er system (the Pyretron Thermal Destruction System by American Combustion, Inc. [ACI]) under the SITE program. Waste material that was excavated from the Stringfellow Superfund site near Riverside, California was used in this SITE project.

Eight tests were performed with the Stringfellow soil—either alone, spiked with hexachloroethane and 1,3,5-trichlorobenzene as POHCs, or mixed with K087 waste. For all tests, the waste feed was packed into fiberpack drums and fed into the rotary kiln incineration system in a cyclical batch charge operation. The tests were set up to evaluate the claims of ACI regarding the capabilities of the Pyretron system relative to feed rate, organic emissions, and economics. Though it was not possible to verify the vendor claim that dynamic oxygen enhancement reduces the magnitude of the transient high levels of organic emissions, CO, and soot that occur with repeated batch charging of waste fed to a rotary kiln, results did indicate that their other two claims

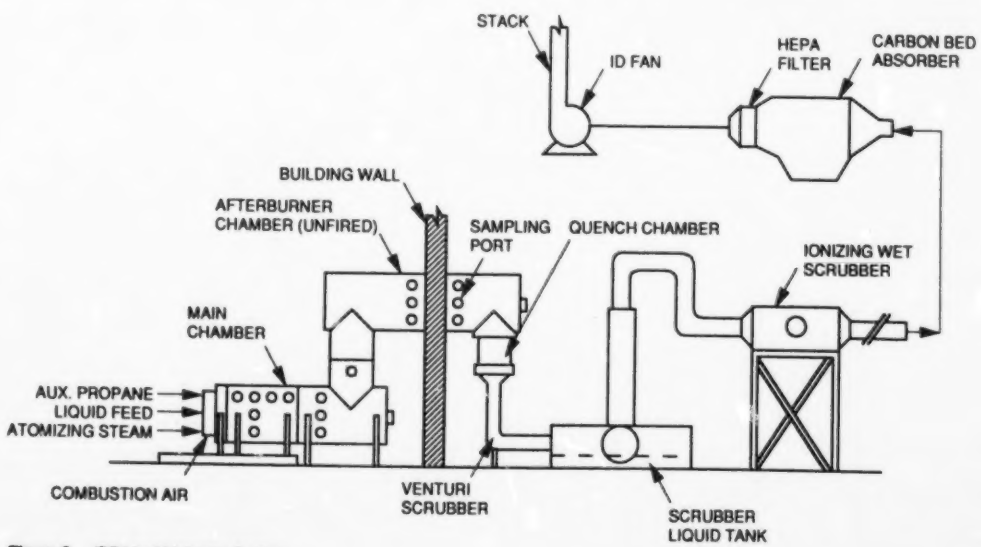

Figure 2. IRF Liquid Injector System.

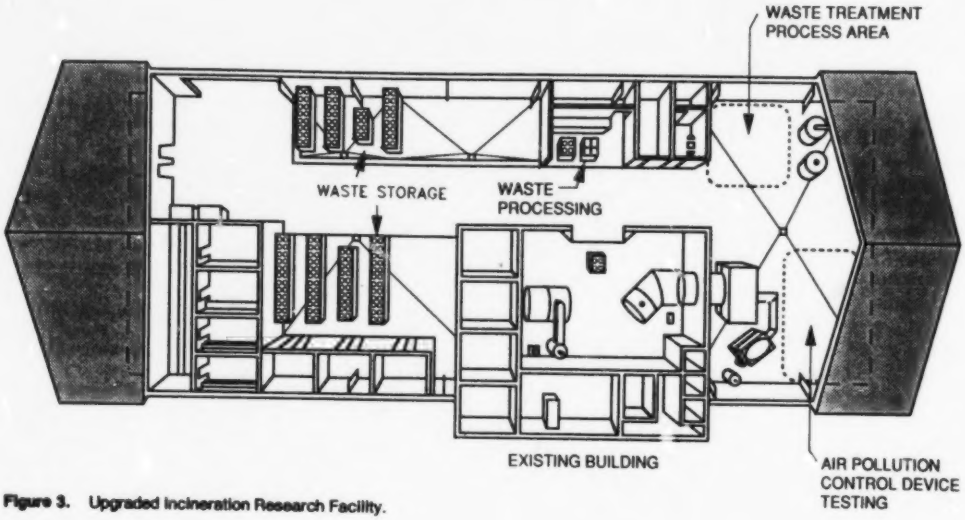

Figure 3. Upgraded Incineration Research Facility.

were sustained, i.e., feed rate and economics. A waste feed-rate double the limit established under conventional operation was possible, while the 99.99 percent POHC DRE was maintained. An economic evaluation of a hypothetical application of the technology to a Superfund remediation effort showed that, for the evaluation case assumed, the Pyretron treatment is projected to be less costly than conventional incineration.

Hazardous Waste Incinerator Compliance Monitoring

Since the regulation of hazardous waste incinerator performance in 1981, EPA has intensified the search for a real-time surrogate compound to use as a means of measuring incinerator compliance to replace the costly and time consuming trial burns now required to obtain a full RCRA operating permit. Sulfur hexafluoride (SF_6) has been suggested as a potential surrogate because of its high thermal stability and its gas chromatographic detectability. To support continuing OSW hazardous waste incinerator regulation development, a series of parametric tests was performed at the IRF using the liquid incinerator system. Primary combustor temperature and excess air (or exit flue gas oxygen) were the parameters varied for this test series. A mixture of organic compounds was prepared to simulate a hazardous waste. The POHCs used in this synthetic waste were chlorobenzene, tetrachloroethylene, pentachlorobenzene, and toluene. POHC DREs and products of incomplete combustion (PICs) were measured. A comparison of POHC DRE and SF_6 DRE showed that the hazardous component's DRE was always equal to or greater than the SF_6 DRE. This series of parametric tests suggests that SF_6 might be a candidate for the trial-burn surrogate.

Trace Metals Emissions Testing

Development of regulations for the control of trace metals emissions has also been supported with studies performed at the IRF. The fate of five trace metals considered hazardous has been studied in a series of tests. At the same time, a series of tests was also conducted on a set of nonhazardous metals with similar properties. Again, as with the SF_6 surrogate work, alternative combinations of nonhazardous metals are also being evaluated to measure incinerator performance. The hazardous metals are: arsenic, barium, cadmium, chromium, and lead. The four nonhazardous metals are: bismuth, copper, magnesium, and strontium. Both sets were fed into the rotary kiln incinerator system, and their volatilities or partitioning were evaluated as functions of temperature and oxygen concentration. The valence state distribution of chromium in emissions and discharges as a function of feed composition and chromium valence state fed was an adjunct subject of this test program. These tests were designed to help evaluate a numerical model which had been developed to predict the relative distributions of trace metals in emissions and discharges from incinerators, as well as

Table I. Listed wastes, characteristics and testing plans.

Listed waste	Listed waste defined	Studies conducted	Results
K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving process that uses creosote and/or pentachlorophenol	DRE, for compliance,	10/11= >99.99%[a]
		residuals characterization,[b]	Low
		particulate levels	Low
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene	DRE, for compliance,	>99.99%
		residuals characterization,	Low
		particulate levels	High
K037	Wastewater treatment sludges from the production of disulfoton	DRE, for compliance,	>99.99%
		residuals characterization,	Low
		particulate levels	High
K086	Solvent washes and sludges from the cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead	DRE, for compliance,	>99.99%
		residuals characterization,	Low
		particulate levels,	High
		trace metals in residuals and particulate	High
K087	Decanter tank tar sludge from coking operations	DRE, for compliance,	>99.99%
		residuals characterization,	Low
		particulate levels	Low

[a] DRE
[b] Related to POHCs.

support the hazardous waste regulations. The results of these tests have been encouraging, and further testing has been planned for the next fiscal year.

Future of the IRF

The greatly expanded research effort at the IRF in FY86 and FY87 challenged the facility's physical capacity. It was decided in 1987 that expansion was necessary if the IRF was to handle these increased demands with safety. The expansion plans include: 1) upgrading the current outside air pollution control system area to approved RCRA containment area status; 2) adding a scrubber water storage tank containment area; 3) adding increased containerized waste storage area; 4) adding waste processing and general work areas; and 5) erecting a steel-walled building over all added containment and work areas, including the existing incinerator building. Figure 3 shows the expanded IRF plan with the existing building noted in the drawing.

Future Testing

Major test programs planned for FY89 after construction at the facility has been completed include: 1) Incinerability testing of two Superfund site wastes in support of EPA Regional Offices; 2) further trace metal testing in support of OSW's incinerator regulation development; 3) demonstration testing of a second SITE thermal technology; and 4) determining effectiveness of various air pollution control devices (APCDs).

Third-party Usage

With the physical expansion of the IRF, the capabilities of research study at the facility have also been expanded. It will now be possible for the Risk Reduction Engineering Laboratory (RREL) of the U.S. EPA to accommodate third-party users at the Arkansas plant. The items that make the facility unique are:

- Fully (RCRA & State) permitted facility, thus cutting red tape
- Quick turnaround when compared with field tests
- RREL participation in third-party evaluations
- Testing platforms (for other combustors/APCDs)
- Cost competitive
- Impartial evaluations
- Disposal of residues
- Top-flight operational people
- Specialized sampling and analysis

EPA is offering, on this limited basis, the IRF and the abilities of its staff to assist in developing information on the users' waste, combustion characteristics, or process/APCD controls. The projects studied must be mutually acceptable and have aspects that are compatible with EPA's overall mission of improving the state-of-the-art of hazardous waste incineration. The information will not be treated as proprietary.

Support of interested non-RREL investigators by IRF will be available on a limited basis beginning in March 1989 and will be fully developed by Fall of that year. Interested parties should contact Marta K. Richards at:

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